

CLAIMS

WHAT IS CLAIMED IS:

1. An LED package, comprising:
 - 5 an LED that emits excitation light at an excitation light wavelength; a layer of phosphor material positioned to receive the excitation light and having a first index of refraction at the excitation light wavelength, the phosphor material emitting visible light at a visible light wavelength when illuminated with the excitation light;
 - 10 an interference reflector positioned adjacent to the layer of phosphor material; and a TIR promoting layer in contact with the layer of phosphor material, the TIR promoting layer having a second index of refraction at the excitation light wavelength that is less than the first index of refraction at the excitation light wavelength.
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2. The LED package according to claim 1, wherein the layer of phosphor material includes a binder material having an index of refraction at the excitation light wavelength that is greater than the second index of refraction of at the excitation light wavelength.
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3. The LED package according to claim 1, wherein the layer of phosphor material includes polyethylene terephthalate.
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4. The LED package according to claim 1, wherein the layer of phosphor material includes zirconia or titania.
5. The LED package according to claim 1, wherein at the excitation light wavelength there is a difference between the first index of refraction at the excitation

light wavelength and the second index of refraction at the excitation light wavelength, and the difference decreases as light wavelength increases from the excitation light wavelength.

5 6. The LED package according to claim 1, wherein at the excitation light wavelength there is a difference between the first index of refraction at the excitation light wavelength and the second index of refraction at the excitation light wavelength, and at the visible light wavelength the first index of refraction is substantially the same as the second index of refraction at the visible light wavelength.

10 7. The LED package according to claim 1, wherein the interference reflector is positioned between the LED and the layer of phosphor material and transmits excitation light and reflects visible light.

15 8. The LED package according to claim 1, wherein the layer of phosphor material is positioned between the interference reflector and the LED and the interference reflector transmits visible light and reflects excitation light.

20 9. The LED package according to claim 8, further comprising a second interference reflector positioned between the LED and the layer of phosphor material that transmits excitation light and reflects visible light.

25 10. The LED package according to claim 7, wherein the interference reflector is non-planar.

11. The LED package according to claim 8, wherein the interference reflector is non-planar.

12. The LED package according to claim 1, wherein the TIR promoting layer is an air gap.
13. The LED package according to claim 1, further comprising an air gap positioned between the layer of phosphor material and the LED.
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14. The LED package according to claim 1, further comprising an air gap positioned above the layer of phosphor material.
- 10 15. The LED package according to claim 1, further comprising an index matching layer of material having a third index of refraction at the visible light wavelength that is substantially the same as or greater than the first index of refraction at the visible light wavelength and in contact with the layer of phosphor material.
- 15 16. The LED package according to claim 1, wherein the TIR promoting layer comprises a microstructured layer.
17. The LED package according to claim 16, wherein the TIR promoting layer has a major surface facing the layer of phosphor material and the major surface has a plurality of prismatic structures.
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18. The LED package according to claim 16, wherein the TIR promoting layer is disposed between the layer of phosphor material and an interference reflector.
- 25 19. The LED package according to claim 18, wherein interference reflector is a short pass interference reflector.
20. The LED package according to claim 1, wherein the TIR promoting layer comprises polymeric material having a refractive index from 1 to 1.5.

21. The LED package according to claim 1, wherein the layer of phosphor material comprises polymeric material having a refractive index from 1.5 to 1.9.

5 22. The LED package according to claim 1, wherein the interference reflector has a concave hemispherical shape.

23. The LED package according to claim 1, wherein the layer of phosphor material has a non-planar shape.